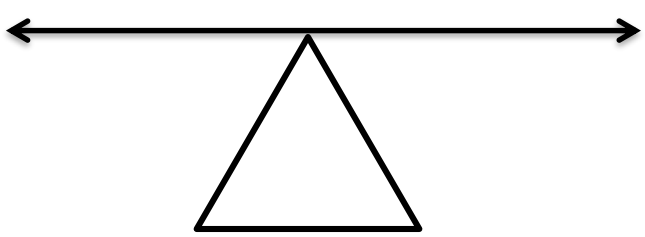
REGULATION OF FOOD INTAKE

AND NUTRITIONAL STATE

INTAKE  **OUTPUT**

CENTER OF SATIETY **-** → **CENTER OF HUNGER**
(permanently active)

ncl. ventromedialis in hypothalamus

lateral hypothalamus
(nucleus under fasciculus telencephalicus medialis)

FEELING OF SATIETY

FOOD INTAKE

Chewing movements

Receptors in nose, mouth, oesophagus, intestine

Mechanoreceptors of stomach

GIT **c**hemoreceptors

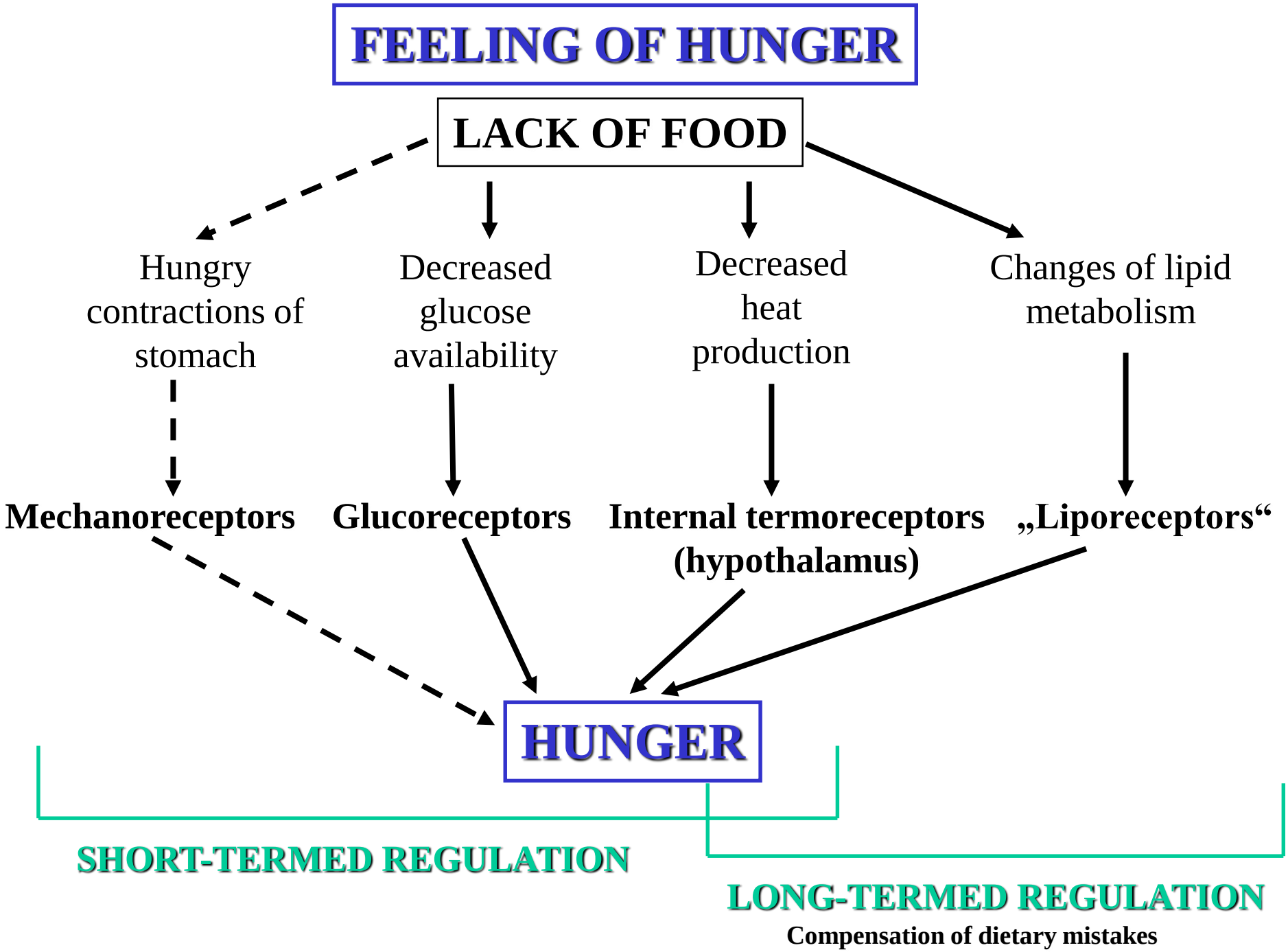
Central gluco- thermo- lipo- receptors

COMPILING THE INFORMATION IN CNS
(CENTER OF SATIETY = ncl. ventromedial in hypothalamus)

PRERESORPTIVE FEEDING

RESORPTIVE FEEDING

SATIETY


FEELING OF HUNGER
LACK OF FOOD
Hungry contractions of stomach
Decreased glucose availability
Decreased heat production
Changes of lipid metabolism
Mechanoreceptors
Glucoreceptors
Internal termoreceptors (hypothalamus)
„Liporeceptors“
HUNGER
SHORT-TERMED REGULATION
LONG-TERMED REGULATION
Compensation of dietary mistakes

REGULATION OF FOOD INTAKE

HYPOTHESIS:

1. Lipostatic
2. H. of GIT peptides
3. Glucostatic
4. Thermostatic

Levels of food intake regulation

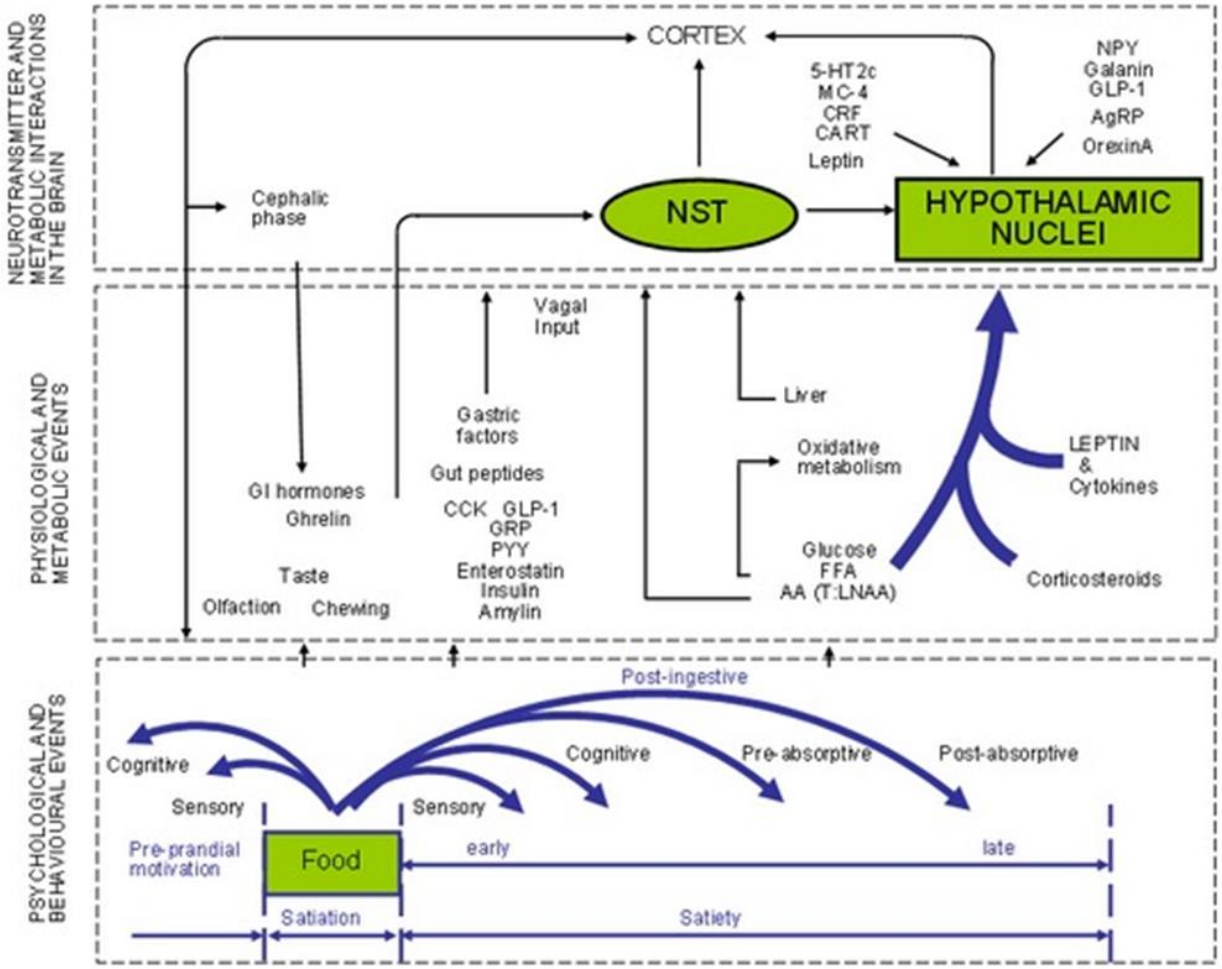


Diagram showing the expression of appetite as the relationship between three levels of operations: the behavioral pattern, peripheral physiology and metabolism, and brain activity. PVN, paraventricular nucleus; NST, nucleus of the tractus solitarius; CCK, cholecystokinin; FFA, free fatty acids; T: LNAA, tryptophan: large neutral amino acids (See (4) for detailed diagram).

OREXIGENIC FACTORS

- Neuropeptide Y
- Orexin A and B (hypocretin 1 and 2)
- Hormon concentrating melanin
- ARP (agouti-related peptide)
- Ghrelin (lenomorelin) – s.-c. hormone of hunger (released from „empty“ stomach)
- Insulin
- Sugars (fructose)

ANOREXIGENIC FACTORS

- POMC – derivative MC4-R
- CRH (corticoliberin)
- CART (cocaine- and amphetamine-regulated transcript)
- Peptide YY (pankreatic peptide; L-cells in ileum and colon, suppresses gastric motility, increases absorption)
- CCK (cholecystokinin)
- glucagon

MEDICAMENTS !!!

Peripheral regulators of apetite

Adipose tissue hormons

- Leptin
- Adiponectin
- Resistin

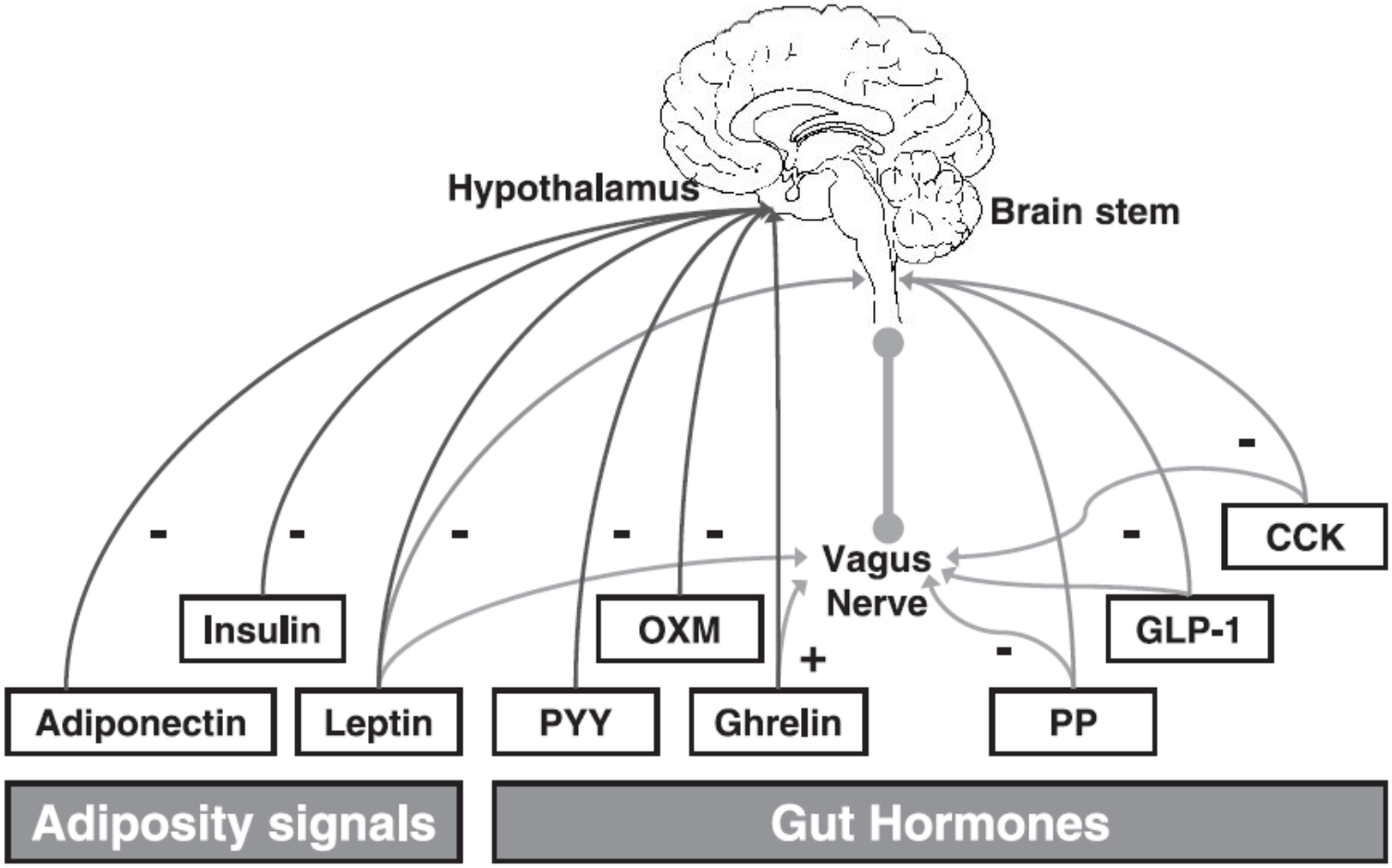
Pancreatic hormones

- Insulin
- Pancreatic polypeptide
- Amylin

GIT hormones

- Peptide YY
- Pancreatic polypeptide
- Ghrelin
- GLP-1
- Oxyntomodulin
- Cholecystokinin
- Bombesin

Peripheral regulators of apetite



LEPTIN (ob-protein)

Secreted by adipocytes into the blood
Binding proteins
Effect on CNS (regulation of body mass and stability of adipose tissue)

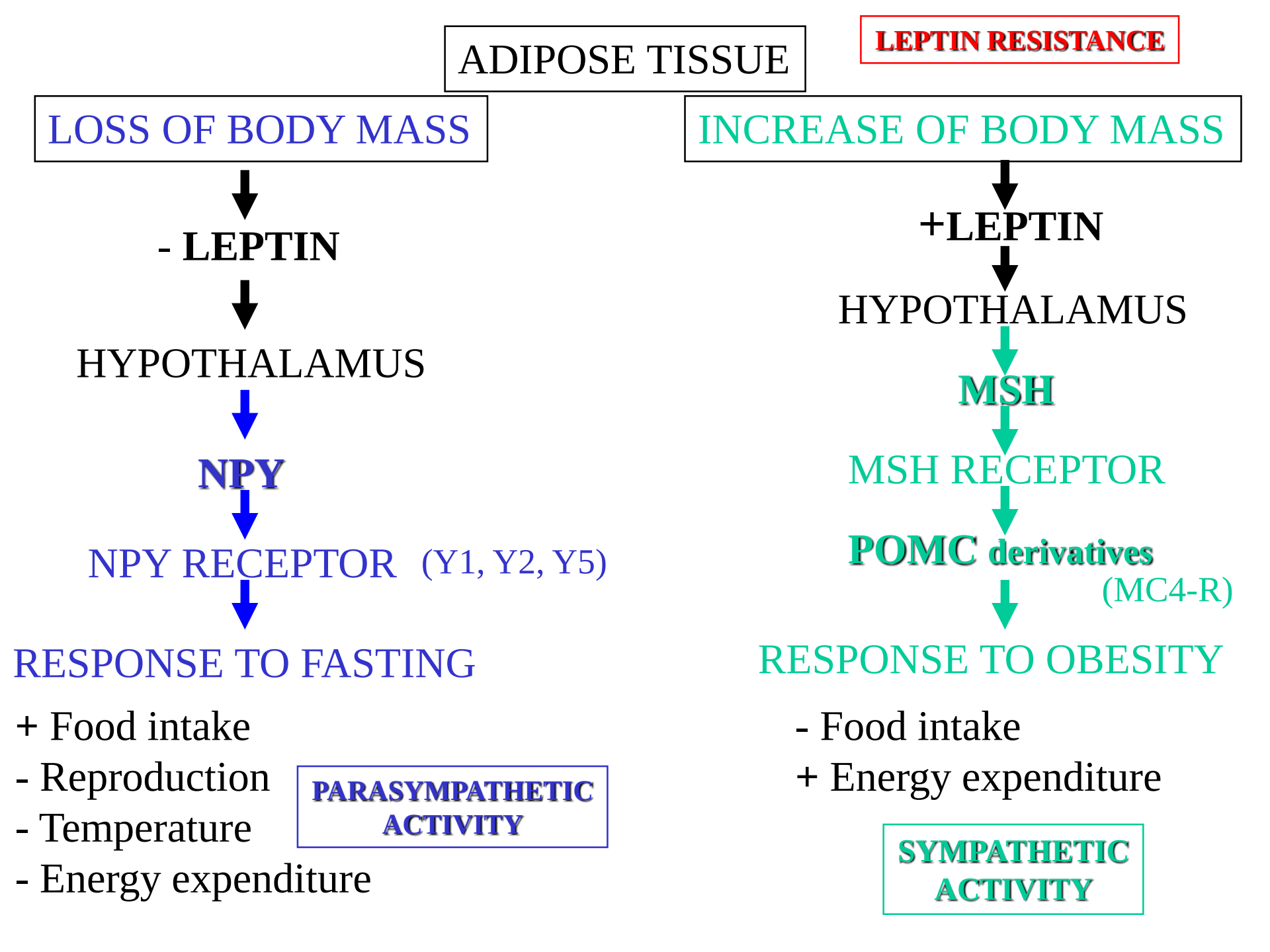
- Pulsative and diurnal character of plasmatic levels
- Free and bound form (in serum)
- SLIM PEOPLE HAVE 2x MORE OF BOND FORM THAN OBESE PEOPLE
- LEPTIN REZISTANCE: often in obese patient with insulin resistance

RECEPTORS from cytokin family
- **Peripheral** (gonads)
- **Central** (hypothalamus, pituitary)

Transduction system is not elucidated

Modulates expression of genes for estrogens.
Regulation of obesity by leptin mediated by NPY and MSH.

Leptin controls adipose tissue by coordination of food intake, metabolism, autonomous nervous system and energy balance.


ADIPOSE TISSUE
LEPTIN RESISTANCE
LOSS OF BODY MASS
INCREASE OF BODY MASS
- LEPTIN
+LEPTIN
HYPOTHALAMUS
HYPOTHALAMUS
NPY
MSH
NPY RECEPTOR (Y1, Y2, Y5)
MSH RECEPTOR
POMC derivatives
(MC4-R)
RESPONSE TO FASTING
RESPONSE TO OBESITY
+ Food intake
- Reproduction
- Temperature
- Energy expenditure
PARASYMPATHETIC ACTIVITY
- Food intake
+ Energy expenditure
SYMPATHETIC ACTIVITY

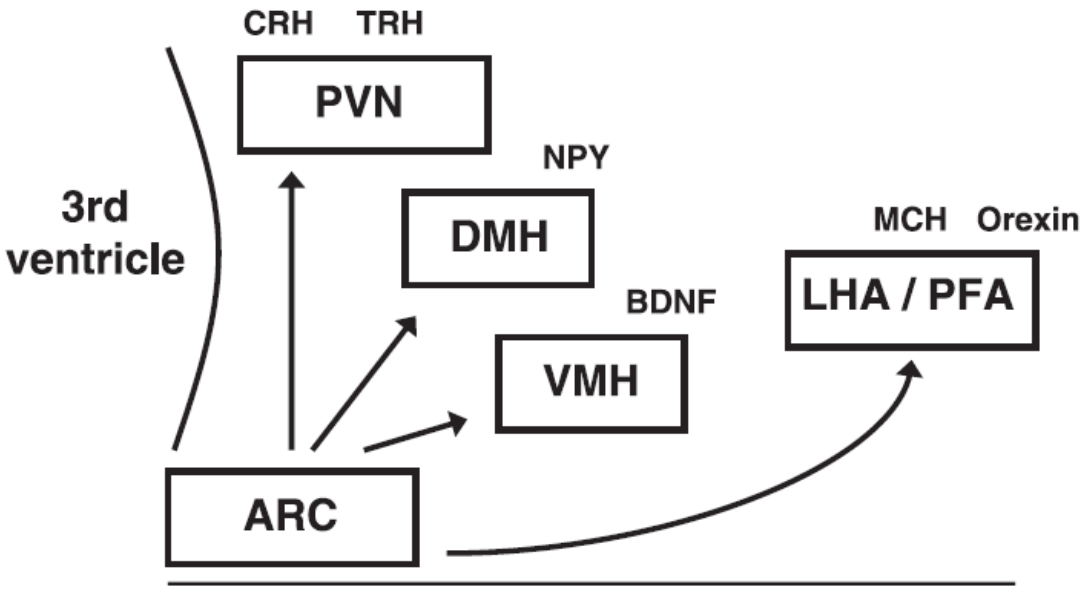
Hypothalamic Structure and Neuronal Pathways Regulating Appetite

Arcuate nucleus

Paraventricular nucleus

Lateral hypothalamic area and perifornical area

Ventromedial nucleus



Hypothalamic Regulators of Appetite

- NPY
- Melanocortin system
- CART

Reward and Regulation of Appetite

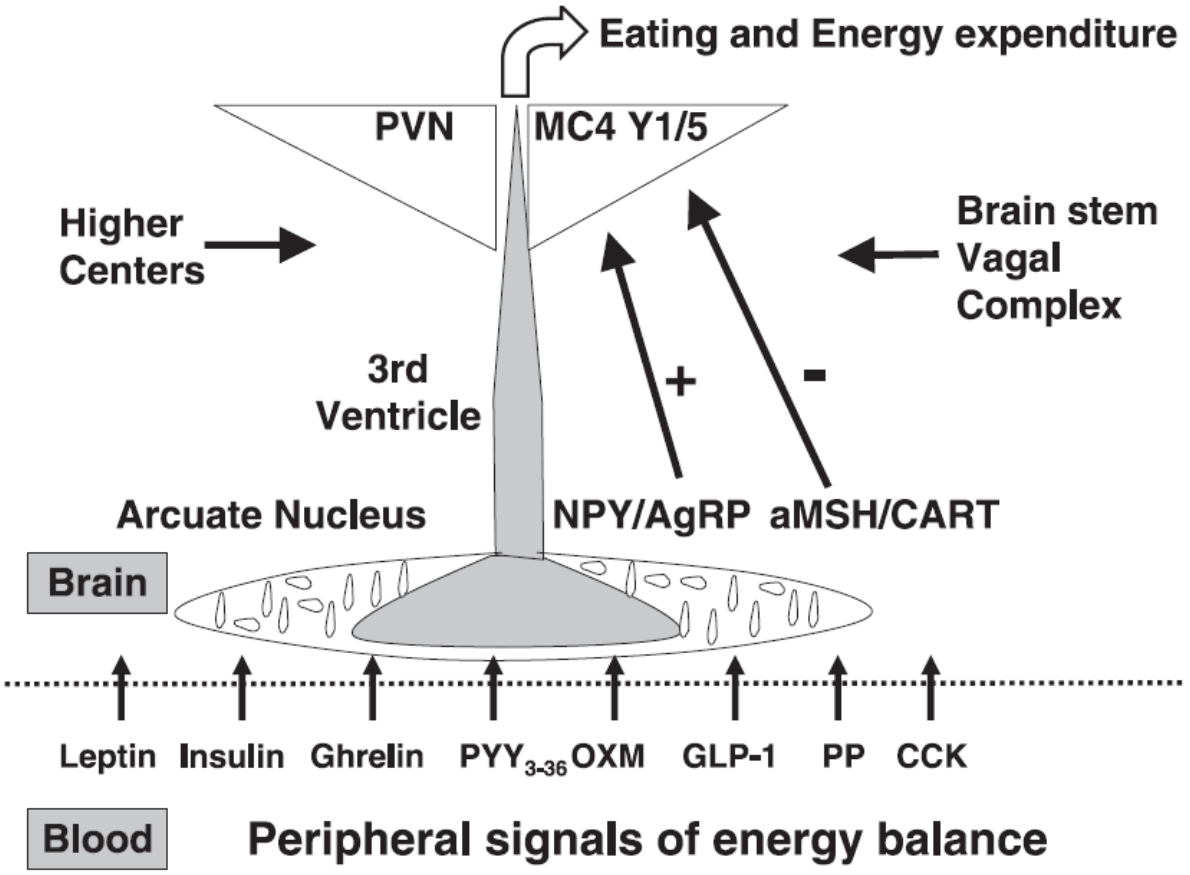
- Opioids
- Endocannabinoids
- Dopaminergic systém
- Serotonin

Brain stem regulators of apetite

- GLT-1
- NPY

- nucleus of the solitary tract!

Model for energy homeostasis



EXAMINATION METHODS

ANTROPOMETRIC METHODS

Inspection
Body mass (kg)
BMI
Waist circumference, waist-to-hip ratio
Percentage of body fat (calliper, impedance methods, densitometry, CT)
Percentage of ABM (%, underwater weighting)
Measurement of big muscle groups

BIOCHEMICAL METHODS

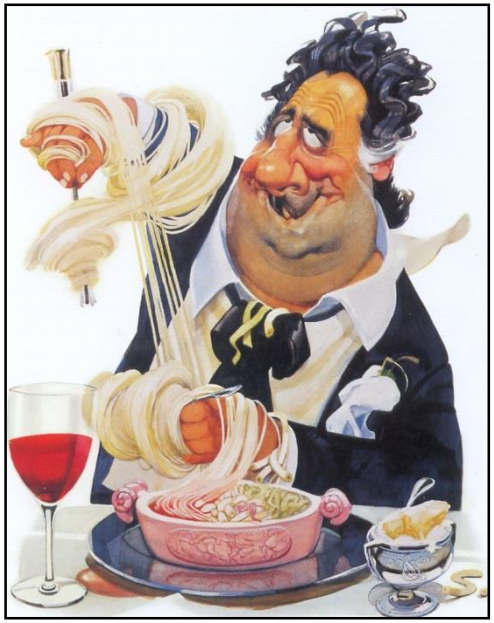
Total nitrogen balance
Loss of nitrogen in urine
Plasmatic values of proteins
Incorporation of AA
Plasmatic levels of prealbumins, transferin
Levels of vitamins or their metabolites in urine…

IMMUNOLOGICAL METHODS

NUTRITION

RECOMMENDED

SPECIAL DIETS



ASPECTS: evolutional
religious
historical

PRINCIPLES OF RECOMMENDED NUTRITION

- Quantity
- Quality
- Special components
- Aesthetics
- Economy

Essential components in nutrition:
AA, FA, vitamins…

Nutritional habits: cultural and historical aspects
social and economical

OBESITY (OVERWEIGHT)

Pathological increase of body mass caused by enormous increase of body fat with serious complications.

INCIDENCE

2008 in CR: **52%** population with higher body mass (35% overweight, 17% obesity), age over 45 – only 30% of population has normal body mass (men – 72% vs. women – 60%)

The percentage of children with obesity increases !!! (2014: 24% boys, 23% girls)

TYPES OF OBESITY:

ALIMENTARY (EXOGENOUS) – overeating

SECONDARY, SYMPTOMATIC

REASONS OF OVEREATING

Family habits vs. GENETIC PREDISPOSITION

Free food

Psychic disorders (depression, food intake disorders)

Religious reasons

Frequency of obesity negatively correlates with education

PROBLEMS RELATED TO OBESITY

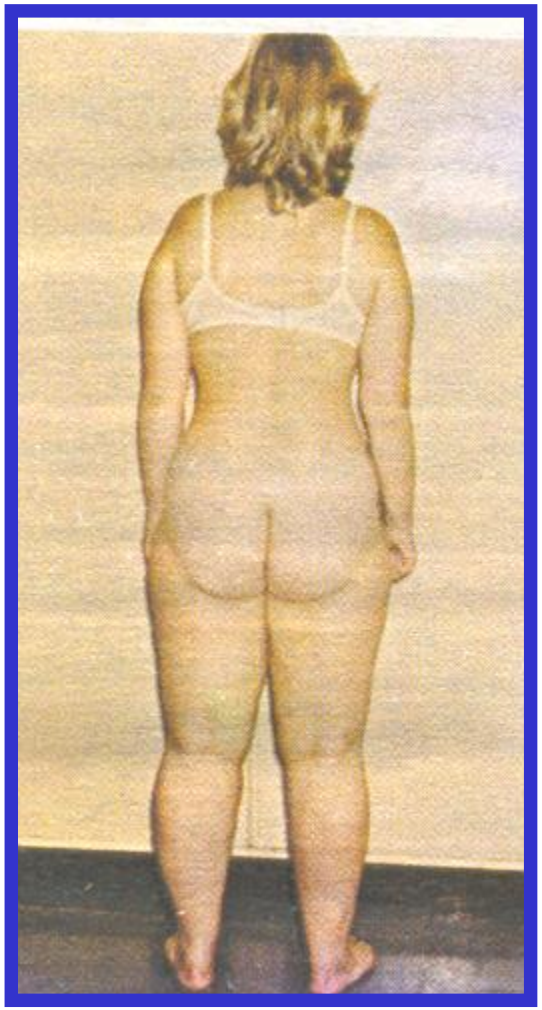
1. Non-agreeable appearance (social isolation, partnership problems, problems to find a corresponding job…)
2. Economical problems (increased expenses for food)
3. Early deterioration of joints (knees, hips, backbone)
4. Varices, thromboses, embolization
5. Diabetes mellitus
6. Dyslipidemia
7. Hypertension
8. Myocardial infarction
9. Brain stroke
10. Malignant tumors !!!
11. Fertility disorders (potency, period)

+ RISK BEHAVIOUR

Fat people die earlier, have worse life and suffer by number of vexatious diseases

FAT DISTRIBUTION

- Diffuse (creeping start of obesity)
- Android (high incidence of DM – type „apple“)
- Gynoid (type „pear“), special type - steatopygia



Madelung collar

Strie

SECONDARY OBESITY

- **Hypercorticalism**
- **Male hypogonadism**
- **Prolactinom**
- **Hypothalamic obesity**

THERAPY OF OBESITY

PREVENTION

1. Restriction of food intake

In men below 11 000 kJ/day, in women – below 8 000 kJ/day

Restriction of saccharides (INZ – antilipophilic hormone), restriction of lipids (sometimes „lipid“ day). NO – salt, spice, alcohol, caffein.

2. Increase of energy expenditure by physical activity

Activity causing increase of HR up to 140-150/min.

Cyclic, swing movements (basic gymnastics)

Swimming in warm water.

3. Additional methods

Anorectics

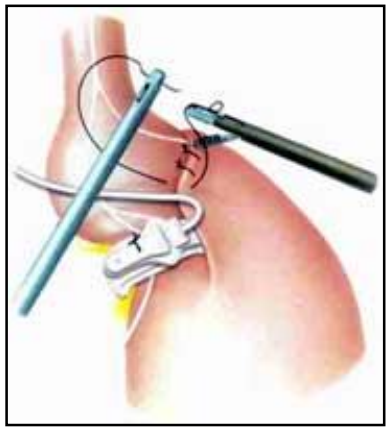
Hormones of thyroid gland

Spa

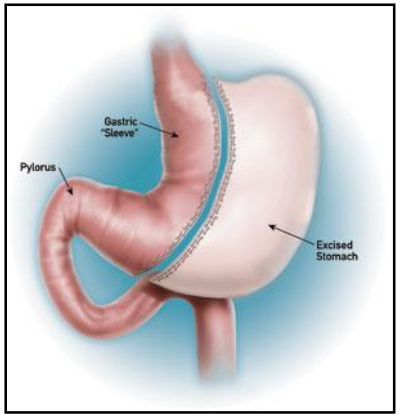
Psychotherapy

Surgical methods – BARIATRIC SURGERY

INTRAGASTRIC BALOON



STOMACH BANDING



SLEEVE-RESECTION OF STOMACH